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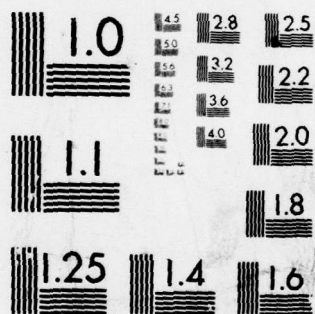
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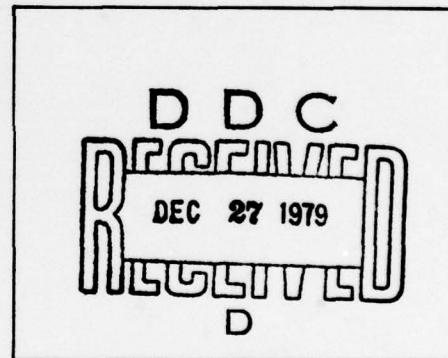
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WIGWAM

May 1955

Project 3.5

EXTERIOR DAMAGE PHOTOGRAPHY OF SUBMERGED TARGETS

Classification (Cancelled) (C)

By Authority of *DIC DNR*

By *R. G. B. C. S. B.* Date *27 May 1975*

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REPORT TO THE SCIENTIFIC DIRECTOR

Project 3.5

EXTERIOR DAMAGE PHOTOGRAPHY OF SUBMERGED TARGETS

By

J. R. R. HARTER
Bureau of Ships
Electronics Design Division
Code 832

D. R. Saveker
Approved by: D. R. SAVEKER
Commander, USN
Director,
Program III

A. B. Focke
Approved: A. B. FOCKE
Scientific
Director

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ABSTRACT

Project 3.5 was established to provide visual examination of submerged objects suspended from surface buoyancy units at depths on the order of 300 feet. The underwater visual system was expected to be maneuverable in the face of relatively steady state currents on the order of 0.50 knot and capable of hovering to permit detail examination by means of an underwater television (UW-TV) equipment and provide an aiming device and platform for a 35mm underwater film camera (UW-film camera) to be furnished by Edgerton, Germeshausen and Grier, Inc. (EG&G).

The Bureau of Ships Electronic Design Division Code 832 has technical responsibility for UW-TV development within the Department of the Navy and was selected on this basis for the preparation of equipment and the conduct of Project 3.5 operations in the field. While no complete equipment having the necessary remotely controlled functions required for the task had ever been developed, UW-TV equipment development and use in the field had been accomplished by the Bureau of Ships to the point where a suitable device could be designed and developed with a high degree of success. The Project 3.5 task was accepted by the Bureau of Ships on 23 June 1954 with 10 months to deliver the equipment to the operating site.

The completed equipment, the AN/SXQ (XN-1), was delivered and installed on shipboard 15 April 1955. After two weeks of shipboard tests, minor modifications and adjustments, the AN/SXQ was determined to be adequate for performance of the specified task.

Due to the course of Operation WIGWAM events, actual performance of the Project 3.5 task was not feasible. Variations of the requisite Project 3.5 performance could have been helpful to the conduct of the operation in several instances, but due to inclement weather a considerable extension of the initially conceived equipment performance characteristics would have been necessary to accomplish these unanticipated tasks.

PREFACE

This report provides data from the development of the first known, fully remotely controlled, self-propelled body for transporting UW-TV, UW-film cameras and other instrumentation for underwater surveillance and exploration.

The development and limited use of this device was of little significance in this operation but it is believed that future underwater operations may be aided and the results therefrom expanded, by the use of similar equipment and techniques.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the services of the Bureau of Ships contractor, the American Machine and Foundry Company, for the development of the AN/SXQ-(XN-1) equipment, completed and ready for tests within a 10 month period. The Director of Program III, CDR D. R. Saveker, USN, and the Chief Planner for the Naval Repair Facility, San Diego, Mr. E. O. Arnold, and his staff enabled the expeditious and excellent shipboard installation and numerous equipment modifications completed in time for the operation. The excellent cooperation and abilities of the Captain, LCDR W. H. Chapman, USN, his officers and the crew of the USS CHANTICLEER (ASR-7) made it possible to carry out tests and adjustments of the new equipment during weather not conducive to operations of this type, without loss or damage to the equipment.

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EXTERIOR DAMAGE PHOTOGRAPHY OF SUBMERGED TARGETS

1 OBJECTIVE AND SCOPE

Project 3.5 was conceived to provide visual assessment of underwater explosion damage to submerged targets (SQUAWS) as soon after the event as possible. This function was deemed advisable because of the high degree of probability that it would be impossible to salvage one or more of the targets for postoperational analysis ashore.

1.1 Task Details

(a) The project 3.5 task as initially conceived, required visual inspection of submerged target hulls (SQUAWS). The targets would be cigar shaped hulls of the submarine type, 120 feet long and 18 feet in diameter, suspended from pontoons to a keel depth of approximately 300 feet. It would be necessary to examine the hulls from all angles and direct photographic coverage was to be made as needed.

(b) Submerged suspension rigging for the SQUAWS would be examined prior to the event to assure that the configuration was in order, if weather and time permitted prior to the event.

(c) In providing this function it was most desirable to eliminate the need for a diver by the use of UW-TV because of the anticipated high degree of contamination of the targets, supporting structures and the sea water. The principal need for visual examination and photographic records was conceived to exist immediately after the event in order to rapidly assess damage and determine the feasibility of the planned salvage operation.

(d) All Project 3.5 functions were to be performed under reasonable weather and surface water conditions from a suitable ship. The configuration of the array of ships and towed targets would result in a current of approximately 0.5 knot at the time of operation. The ship that carried the Project 3.5 equipment would be secured to the flotation unit, from which the SQUAW was suspended during each submerged hull examination, to minimize the three dimensional underwater navigational problem and the possibility of fouling equipment control cables with the SQUAW suspension and towing lines.

2 EQUIPMENT DESIGN PHILOSOPHY

(a) As in most Bureau of Ships applications of UW-TV, the Project 3.5 task required a stable, controlled platform for the UW-TV camera. Controlled movement in a known direction and depth were also requisite but the rate of movement could be slow with a propulsion reserve as necessary to cope with low velocity ocean currents. Therefore the principal design effort was directed towards the development of a critically depth controlled hovering platform capable of relatively slow, limited movement in the horizontal plane.

2.1 Hydrodynamic Considerations

(a) Uniform drag characteristics in all direction of movement seemed to be most desirable. The most significant deterrent to movement of the underwater unit would be control cable to the surface control station. Due to the time factor, it would be impossible to pursue the necessary development or component construction for significant reduction of the control cable diameter to the desired minimum dimension. All controls would be simply effected by individual conductive circuits. A cable diameter of 1.75 inches would be required and this would be the principle drag imposed upon the Mobile UW-TV Unit. This drag factor would be increased by the necessary cable flotation units for neutral buoyancy. A spherical float 1.0 foot in diameter, attached to the cable at 30.0 foot intervals would suffice for a cable having polyethylene insulation and PVC sheathing.

(b) Cable drag being the predominate influence on the movement of the underwater vehicle, the size limits of the vehicle itself would be determined by the mechanism required to tow the anticipated maximum length of cable in a typical depth to length configuration and perform the Project 3.5 functions detailed in Section 1.1.

2.2 Fundamental Principle of Operation

(a) The fundamental principle of operation for the Mobile UW-TV Unit developed for this task is realized by a constant displacement buoyancy element which supports the total underwater unit. A propeller exerting vertical thrust towards the surface provides the "diving" and hovering force to counter the constant positive buoyancy of the unit. The vertical screw provides controlled thrust over a range of negative 300 pounds to positive 300 pounds and can therefore satisfactorily provide controlled submersion and hovering with the unit positive buoyancy set at a typical value of 50 pounds. In addition to providing controlled descent and ascent of the unit this system has an excellent "fail safe" characteristic.

(b) The control cable is attached to the underwater unit by a bail which rotates freely about the vertical axis of the unit with a total range of 325°. The cable bail is also free to swing through a vertical arc of 160°, about its mounting trunnions which are located

at the drag center of the underwater unit.

(c) Horizontal propulsion motors, gear box and propeller units are mounted essentially at the drag center, just below the plane of attachment for the rotating cable bail. The center of gravity is slightly below the center of drag. Vertical stability of the underwater unit is therefore assured when underway, at rest on the bottom, or in a hovering altitude. Motors and gear boxes are free flooding.

(d) Figures 1 and 2 show the principal units of the Mobile UW-TV Equipment, AN/SXQ(XN-1), in the final stages of development (Section 7).

2.3 Detailed Design Factors for the Mobile UW-TV Equipment

(a) Controlled descent and ability to hover at depths from surface to 300 feet.

(b) Controlled horizontal movement at all depths to 300 feet as necessary to hover in the face of currents up to 1.0 knot.

(c) Controlled pan and tilt of the UW-TV camera to provide viewing throughout an inverted hemispherical zone based on a horizontal plane.

(d) Controlled UW-film camera direction simultaneous and coincident with the central portion of the UW-TV viewing field. (The film camera to be supplied by Edgerton, Germeshausen and Grier, Inc. complete and suitable for mounting on the UW-TV camera.) Film camera exposures to be made by a simple control located at the control console of the Mobile UW-TV Equipment.

(e) Cable handling and storing facilities to minimize damage to the UW-TV Unit control cable and to simplify deck handling and maintain relatively constant cable tension when the UW-TV Unit is in operation.

(f) Total control of the Mobile UW-TV Unit and all auxiliary equipment including motor generators, cable reel, and UW-film camera from a console that will permit at least 3 operators to function efficiently, in the performance of the necessary system controls.

(g) Underwater illumination for the UW-TV camera to provide satisfactory images of underwater scenes 20 feet in depth under conditions of total absence of natural illumination and reasonable water clarity. (UW-film camera unit includes an electronic flash illumination system synchronized with the between the lens shutter and is totally automatic in operation when the shutter is released.)

(h) Instrumentation of the Mobile UW-TV Unit to include the following remote reading instruments:

1. Gyro compass for true heading data

2. Depth gauge, calibrated from 0 to 600 feet in 0.5 foot increments with response comparable to the vertical terminal velocity of the Mobile UW-TV Unit.

3. Flow gauge calibrated 0 to 5 knots in increments of 0.1 knot.

4. Current flow direction indicator to provide current flow data relative to the heading of the Mobile UW-TV Unit.

5. Port and starboard and vertical propeller R.P.M. indicators with forward and reverse rotation indication.

6. Acoustical monitoring system to provide the operators with aural monitoring of various functions comprising the Mobile UW-TV Unit for an easily assimilated control response feed back function.

7. Primary air supply and low pressure warning system.

8. Leak detection system for the UW-TV camera unit.

9. Leak detection system for the pressurized gyro-compass unit.

(i) Additional performance and function monitoring instrumentation required as follows:

1. Cable pay out footage indicator system

2. Cable tension measuring system

3. UW lamp voltage and current measuring system incorporated with brightness control.

4. Metering system for all electrical power circuits to the Mobile UW-TV Unit.

5. Operating time indicators for all principal components of the total system that will require maintenance or replacement or operating life study.

(j) In addition to the listed instrument items, the pan and tilt coverage of the UW-TV camera should provide visual examination of many external parts of the system. Horizontal propulsion screws, flow transducer, buoyancy chamber vents, control cable configuration and certain other data not feasible to be transmitted to the surface by conductive circuits.

3 SHIPBOARD INSTALLATION OF PROJECT 3.5 EQUIPMENT

The U.S.S. CHANTICLEER (ASR-7) was selected for Project 3.5 use because of its facilities for deck installation and handling of the AN/SXQ equipment as well as the general salvage task assignment for this ship which was compatible with anticipated Project 3.5 functions.

3.1 Installation Details

The shipboard installation of the AN/SXQ was completed 16 April at the U.S. Naval Repair Facility, San Diego.

(a) A 9x14 foot temporary deck house was installed aft of the 01 deck level, supported at this level by tubular steel columns. This structure housed the Control Console Unit of the AN/SXQ and a TV film recording assembly composed of a high resolution TV image monitor and an Auricon 16mm, recording film camera supplied by the U.S. Air Force Video Production Squadron.

(b) A 75 KW, 3 phase, 208 volt alternating current, skid type motor generator was installed amidships for all primary input power for the AN/SXQ equipment.

(c) The 3 variable frequency alternators, driven by 3 phase, 208 volt alternating current, 15 HP motors that provide the vertical and horizontal propulsion motors of the mobile UW-TV Unit with input power, were installed on a transverse truss between the two forward support columns for the deck house.

(d) A 1 KW, 400 cycle alternator, driven by a 2 HP, 3 phase, 208 volt alternating current motor was installed on the extreme after portion of the 01 deck. This unit supplied input power for AN-SXQ instrumentation including the gyro compass and remote indicator, flow transducer and relative flow direction remote indicating system and the remote indicating depth measure system.

(e) The cable reel for the Mobile UW-TV Unit control cable was installed on an elevated platform 6 feet above the weather deck, at the stern.

(f) A cable stayed, deck chock type of weather deck mounting was devised for the mobile UW-TV Unit on the starboard side of the weather deck, alongside the deck house installation. This location was determined by the desired operating method planned with the advice of the ships First Lieutenant and planned use of the main hoisting boom to place the unit in the water. The Mobile UW-TV Unit was thus in a starboard deck location identical with the port site of the Submarine Rescue Bell and similar deck and over-the-side handling techniques could be employed to launch the UW-TV unit.

(g) A TV image monitor was installed in the Wardroom for additional viewing space due to the limited number of viewers that could be accommodated at the control installation.

(h) Ship's high pressure air for recharging the compressed air flasks in the Mobile UW-TV Unit was made available by a special line terminated underneath the deck house; an additional air line was terminated at the end of the Control Console in the deck house. The deck house line was fitted with a "Dome Loader" to provide an auxiliary diving air feed to the Mobile UW-TV Unit by flexible hose.

(i) Special tackle for easy coupling and release of the Mobile UW-TV Unit, when launched and retrieved, was devised and constructed by the CHANTICLEER personnel in conjunction with the Project 3.5 personnel. This gear was continuously revised during the test period. The tackle played a very critical part in the operating procedure by reducing the hazard to deck personnel when sea states two and three were encountered.

4 PRE-OPERATIONAL TESTS

Initial deep water tests of the AN/SXQ equipment were made aboard the U.S.S. CHANTICLEER due to the time element imposed upon the total development.

4.1 The first dive to 220 feet near Catalina Island resulted in a badly collapsed buoyancy chamber and the Mobile UW-TV Unit was retrieved from the bottom by hauling in on the control cable. No damage to the electronics or other functional parts was sustained. The failure was attributed to diving the unit at a rate in excess of the maximum pressure equalization capabilities of the demand type air system. The mass rate of inlet air flow to the buoyancy chamber was doubled by the addition of additional solenoid controlled valves and regulators. This modification provided air at a flow rate in excess of any demand that could result from diving rates up to the calculated 6 feet per second terminal velocity of the unit. The buoyancy chamber was rebuilt at the U.S. Naval Repair Facility.

4.2 During the second and final test near South Coronado Island in an area of 30 to 60 fathoms depth, excellent underwater performance was achieved to depths of 180 feet. The unit was repeatedly taken down to a predetermined depth and brought to a hovering condition with excellent control response to all demands made by the operators. The unit was found to be highly maneuverable in the horizontal plane. All instruments performed perfectly and it became very apparent that the major need for further tests resided in the operator's inexperience. A final dive was made to gain experience in depths typical of the forthcoming operation. At 240 feet the TV system failed in a manner that was immediately analyzed as a failure of the Image Multiplier Orthicon tube. The leak detection system indicated continued watertight integrity, therefore the failure of the TV function alone was very

peculiar. Upon retrieving the unit, it was discovered that buoyancy chamber air pressure (approximately 115 psi at the depth where failure occurred) had been transmitted to the UW-TV camera housing through the TV camera cable sheath and terminal fitting. The UW-TV camera housing must be maintained at or near atmospheric pressure due to the lack of resistance to implosion of the Image Multiplier Orthicon tube at pressures in excess of this value. It was assumed that the watertight connectors, employed for the UW-TV camera housing to buoyancy chamber connection of the TV cable, would also block the anticipated maximum air pressure differential of approximately 150 psi that would exist between these two chambers. Upon return to the U.S. Naval Repair Facility this fault was remedied by potting the cable fitting on the high pressure end of the system with an Epoxy compound. The modified cable was successfully pressure tested for two hours at a pressure of 175 psi employing a small pressure vessel fabricated to house the plastic impregnated connector.

4.3 It was impossible to conduct further tests prior to the operation, but due to the nature of the only failure experienced and the positive remedial measures taken, this situation was not considered to jeopardize the Project 3.5 function.

5 OPERATION WIGWAM

The entire period covered by the operation was characterized by inclement weather which resulted in no realization of the Project 3.5 function.

5.1 Two days out of San Diego on the return voyage, an attempt was made to examine the trailing end of a submerged cable bundle towed by a YFNB. Due to the sea state 2 condition, the U.S.S. CHANTICLEER could not safely secure to the YFNB. The Mobile UW-TV Unit was launched while the CHANTICLEER laid to, approximately 100 feet away from the point where the slowly moving YFNB would pass. The ARS, which had the YFNB in tow, had reduced her speed to a few revolutions. It was anticipated that the YFNB would be essentially motionless as it came abreast of the ASR-7 providing a reasonably good approximation of the principal Project 3.5 task. The Mobile UW-TV Unit was launched and maneuvered into a diving position approximately 30 feet from the port side of the advancing YFNB. The dive was made to approximately 40 feet and by virtue of data from the flow gauge and gyro compass, the position was held until the trailing cable bundle appeared on the UW-TV viewing monitor. Due to the narrow field of view (38°) and the approximate 30 foot distance to the subject it swept across the screen rapidly. Slow response of the UW-TV azimuth control system caused the subject to be lost from view before the underwater unit could be directed along a parallel course with the moving cable bundle. Continued efforts were made to reestablish visual contact but it was necessary for ASR-7 to continuously maneuver to maintain any semblance of a fixed operating station alongside the YFNB due to the prevailing current and the slight headway maintained by the ARS and its tow. It became necessary to pay

out 1000 feet of control cable to prevent towing the Mobile UW-TV Unit during the maneuvering of the ASR-7. The total effect was sufficient to rather thoroughly confuse the AN/SXQ operators who already had a complex underwater navigational problem. The drag of the 1000 feet of control cable reduced the maneuverability of the underwater unit in its slow progress against the current.

After 40 minutes of operation the exercise was terminated at the request of the Project Officer. This request was made because of the danger of fouling the ships screw or sustaining serious equipment damage or loss due to attempting an unrehearsed operation that required performance beyond the design characteristics of the AN/SXQ(XN-1) equipment.

6 SUMMARY

The course of events of the operation precluded the performance of the Project 3.5 function and therefore no contribution was made to Operation WIGWAM.

6.1 Technical Significance

The expeditious completion the interim model of the Mobile UW-TV Equipment (AN/SXQ(XN-1)) is a considerable contribution to the field of underwater research in general and, specifically, towards the early perfection of a practical, remotely controlled submersible body or carrier that may be tailored to suit the needs of military and scientific instrumentation for undersea operations and research. Without the impetus of the WIGWAM sponsorship and needs, several years could have been consumed in the assiduous conduct of the original Bureau of Ships development prior to the fabrication of a model for field evaluation. As a result of the Project 3.5 experience it is readily conceived to be more valuable to have an operable equipment of less than the original Bureau of Ships performance characteristics in hand for operational tests during the next year, than to have pursued the planned two year development. The empirical nature of a total development program to produce the unique hydromechanical device that will fulfill naval underwater visual and general surveillance needs will be well served by the AN/SXQ (IN-1) in the future.

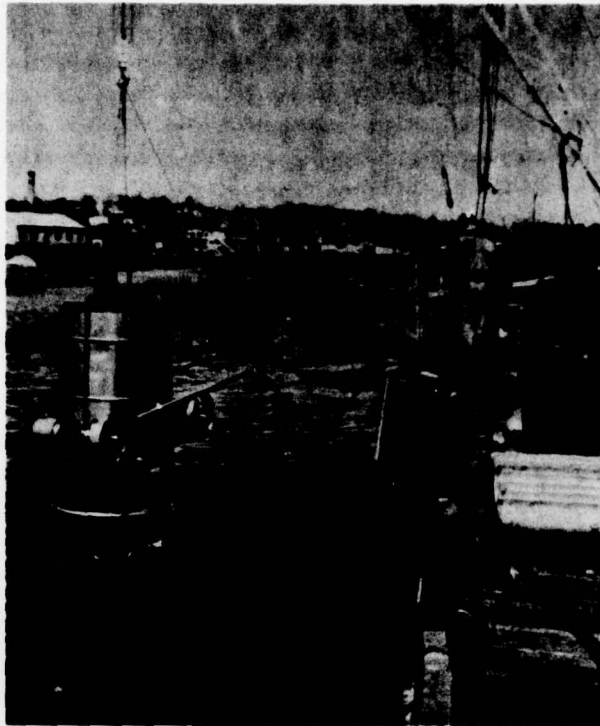


Figure 1 Initial tests of the Mobile UW-TV Unit, a unit of the interim model of the Mobile UW-TV Equipment AN/SXQ (XN-1).

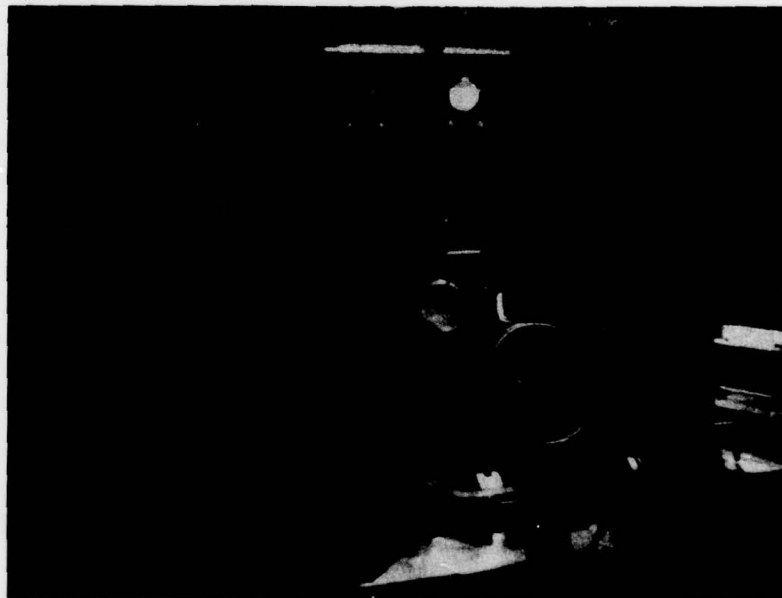


Figure 2 The near completed AN/SXQ (XN-1) Control Console Unit.

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- 88 Director of Naval Intelligence, D/N, Washington 25, D.C. ATTN: OP-922V
- 89 Chief, Bureau of Medicine and Surgery, D/N, Washington 25, D.C. ATTN: Special Weapons Defense Div.
- 90 Chief, Bureau of Ordnance, D/N, Washington 25, D.C.
- 91 Chief of Naval Personnel, D/N, Washington 25, D.C.
- 92 Chief, Bureau of Ships, D/N, Washington 25, D.C. ATTN: Code 348

- 93 Chief, Bureau of Yards and Docks, D/N, Washington 25, D.C. ATTN: D-440
- 94 Chief, Bureau of Supplies and Accounts, D/N, Washington 25, D.C.
- 95-96 Chief, Bureau of Aeronautics, D/N, Washington 25, D.C.
- 97 Chief of Naval Research, Department of the Navy Washington 25, D.C. ATTN: Code 811
- 98-99 Commander-in-Chief, U.S. Pacific Fleet, Fleet Post Office, San Francisco, Calif.
- 100-101 Commander-in-Chief, U.S. Atlantic Fleet, U.S. Naval Base, Norfolk 11, Va.
- 102 Commandant, U.S. Marine Corps, Washington 25, D.C. ATTN: Code A03H
- 103 President, U.S. Naval War College, Newport, R.I.
- 104 Superintendent, U.S. Naval Postgraduate School, Monterey, Calif.
- 105 Commanding Officer, U.S. Naval Schools Command, U.S. Naval Station, Treasure Island, San Francisco, Calif.
- 106 Director, USMC Development Center, USMC Schools, Quantico, Va.
- 107 Commanding Officer, U.S. Fleet Training Center, Naval Base, Norfolk 11, Va. ATTN: Special Weapons School
- 108-109 Commanding Officer, U.S. Fleet Training Center, Naval Station, San Diego 36, Calif. ATTN: (SFWP School)
- 110 Commanding Officer, Air Development Squadron 5, VI-5, U.S. Naval Air Station, Moffett Field, Calif.
- 111 Commanding Officer, U.S. Naval Damage Control Training Center, Naval Base, Philadelphia 12, Pa. ATTN: ABC Defense Course
- 112 Commanding Officer, U.S. Naval Unit, Chemical Corps School, Army Chemical Training Center, Ft. McClellan, Ala.
- 113 Commander, U.S. Naval Ordnance Laboratory, Silver Spring 19, Md. ATTN: EE
- 114 Commander, U.S. Naval Ordnance Laboratory, Silver Spring 19, Md. ATTN: EH
- 115 Commander, U.S. Naval Ordnance Laboratory, Silver Spring 19, Md. ATTN: R
- 116 Commander, U.S. Naval Ordnance Test Station, Inyokern, China Lake, Calif.
- 117 Officer-in-Charge, U.S. Naval Civil Engineering Res. and Evaluation Lab., U.S. Naval Construction Battalion Center, Port Hueneme, Calif. ATTN: Code 753
- 118 Commanding Officer, U.S. Naval Medical Research Inst., National Naval Medical Center, Bethesda 14, Md.
- 119 Director, U.S. Naval Research Laboratory, Washington 25, D.C. ATTN: Code 2029
- 120 Director, The Material Laboratory, New York Naval Shipyard, Brooklyn, N.Y.
- 121 Commanding General, Fleet Marine Force, Atlantic, Norfolk, Va.
- 122 Commanding Officer and Director, U.S. Navy Electronics Laboratory, San Diego 52, Calif. ATTN: Code 4223
- 123-126 Commanding Officer, U.S. Naval Radiological Defense Laboratory, San Francisco 24, Calif. ATTN: Technical Information Division
- 127 Director, Naval Air Experimental Station, Air Materiel Center, U.S. Naval Base, Philadelphia, Penn.
- 128 Officer-in-Charge, Special Weapons Supply Depot, U.S. Naval Supply Center, Norfolk 11, Va.
- 129 Commanding Officer and Director, David W. Taylor Model Basin, Washington 7, D.C. ATTN: Library
- 130-131 Commanding Officer, U.S. Naval Photographic Center, Anacostia, D.C.
- 132 Commander, U.S. Naval Air Development Center, Johnsville, Pa.
- 133 Director, Office of Naval Research Branch Office, 1000 Geary St., San Francisco, Calif.
- 134 Commanding Officer, Clothing Supply Office, Code 1D-0, 3rd Avenue and 29th St., Brooklyn, N.Y.
- 135 Commandant, U.S. Coast Guard, 1300 E. St. N.W., Washington 25, D.C. ATTN: Capt. J. R. Stewart
- 136 Commanding General, Fleet Marine Force, Pacific, Fleet Post Office, San Francisco, Calif.
- 137-143 Technical Information Service, Oak Ridge, Tenn. (Surplus)
- 147 Director of Operations, Headquarters, USAF, Washington 25, D.C. ATTN: Operations Analysis
- 148 Director of Operations, Headquarters, USAF, Washington 25, D.C.
- 149 Director of Plans, Headquarters, USAF, Washington 25, D.C. ATTN: War Plans Div.
- 150 Directorate of Requirements, Headquarters, USAF, Washington 25, D.C. ATTN: AFDRQ-SA/M
- 151 Director of Research and Development, Headquarters, USAF, Washington 25, D.C. ATTN: Combat Components Div.
- 152-153 Director of Intelligence, Headquarters, USAF, Washington 25, D.C. ATTN: AFOIN-IB2
- 154 The Surgeon General, Headquarters, USAF, Washington 25, D.C. ATTN: Bto. Def. Br., Pre. Med. Div.
- 155 Deputy Chief of Staff, Intelligence, Headquarters, U.S. Air Forces Europe, APO 633, c/o FM, New York, N.Y. ATTN: Directorate of Air Targets
- 156 Commander, 497th Reconnaissance Technical Squadron (Augmented), APO 633, c/o FM, New York, N.Y.
- 157 Commander, Far East Air Forces, APO 925, c/o FM, San Francisco, Calif.
- 158-159 Commander, Alaskan Air Command, APO 942, c/o FM, Seattle, Wash. ATTN: AACIN
- 160 Commander, Northeast Air Command, APO 862, c/o FM, New York, N.Y.
- 161 Commander-in-Chief, Strategic Air Command, Offutt Air Force Base, Omaha, Nebraska. ATTN: Special Weapons Branch, Inspection Div., Inspector General
- 162 Commander, Tactical Air Command, Langley AFB, Va. ATTN: Documents Security Branch
- 163 Commander, Air Defense Command, Ent AFB, Colo.
- 164-165 Commander, Wright Air Development Center, Wright-Patterson AFB, Dayton, O. ATTN: WCRDM, Blast Effects Research
- 166 Commander, Air Materiel Command, Wright-Patterson AFB, Dayton, O. ATTN: MCSW
- 167 Commander, Air Training Command, Scott AFB, Belleville, Ill. ATTN: DCS/O GTP
- 168 Commander, Air Research and Development Command, PO Box 1395, Baltimore, Md. ATTN: RDM
- 169 Commander, Air Proving Ground Command, Eglin AFB, Fla. ATTN: AG/VRB
- 170-171 Director, Air University Library, Maxwell AFB, Ala.
- 172-179 Commander, Flying Training Air Force, Waco, Tex. ATTN: Director of Observer Training
- 180 Commander, Crew Training Air Force, Randolph Field, Tex. ATTN: 2GTS, DCS/O
- 181 Commander, Headquarters, Technical Training Air Force, Gulfport, Miss. ATTN: TA&D
- 182-183 Commandant, Air Force School of Aviation Medicine, Randolph AFB, Tex.
- 184-185 Commander, Wright Air Development Center, Wright-Patterson AFB, Dayton, O. ATTN: WCOSI
- 186-187 Commander, Air Force Cambridge Research Center, LG Hanscom Field, Bedford, Mass.
- 188-190 Commander, Air Force Special Weapons Center, Kirtland AFB, N. Mex. ATTN: Library
- 191 Commandant, USAF Institute of Technology, Wright-Patterson AFB, Dayton, O. ATTN: Resident College
- 192 Commander, Lowry AFB, Denver, Colo. ATTN: Department of Armament Training
- 193 Commander, 1009th Special Weapons Squadron, Headquarters, USAF, Washington 25, D.C.
- 194-195 The RAND Corporation, 1700 Main Street, Santa Monica, Calif. ATTN: Nuclear Energy Division
- 196 Commander, Second Air Force, Barksdale AFB, Louisiana. ATTN: Operations Anal. Office
- 197 Commander, Eighth Air Force, Westover AFB, Mass. ATTN: Operations Anal. Office
- 198 Commander, Fifteenth Air Force, March AFB, Calif. ATTN: Operations Anal. Office
- 199-205 Technical Information Service, Oak Ridge, Tenn. (Surplus)

OTHER DEPARTMENT OF DEFENSE ACTIVITIES

- 206 Executive Secretary, Joint Chiefs of Staff, Washington 25, D.C.
- 207-208 Asst. Secretary of Defense, Research and Development, D/D, Washington 25, D.C. ATTN: Tech. Library
- 209 U.S. Documents Officer, Office of the U.S. National Military Representative-SHAPE, APO 55, New York, N.Y.
- 210 Director, Weapons Systems Evaluation Group, OSD, RM 2E1006, Pentagon, Washington 25, D.C.
- 211 Asst. for Civil Defense, OSD, Washington 25, D.C.

AIR FORCE ACTIVITIES

- 144 Asst. for Atomic Energy, Headquarters, USAF, Washington 25, D.C. ATTN: DCS/O
- 145 Asst. for Development Planning, Headquarters, USAF, Washington 25, D.C.
- 146 Deputy for Materiel Atomic Energy Control, Asst. for Materiel Program Control, DCS/M, Headquarters, USAF, Washington 25, D.C. ATTN: AFMPC-AE

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- 212 Armed Services Explosives Safety Board, D/D, Building
T-7, Gravelly Point, Washington 25, D.C.
213 Executive Secretary, Military Liaison Committee, PO
Box 1814, Washington 25, D.C.
214 Commandant, National War College, Washington 25, D.C.
ATTN: Classified Records Library
215 Commandant, Armed Forces Staff College, Norfolk 11,
Va. ATTN: Secretary
216 Commandant, Industrial College of the Armed Forces,
Ft. Lesley J. McHair, Washington 25, D.C.
217-222 Commanding General, Field Command, Armed Forces Spe-
cial Weapons Project, PO Box 5100, Albuquerque, N.
Mex.
223-224 Commanding General, Field Command, Armed Forces, Special
Weapons Project, PO Box 5100, Albuquerque, N. Mex.
ATTN: Technical Training Group
225-233 Chief, Armed Forces Special Weapons Project, Washington
25, D.C. ATTN: Document Library Branch
234 Commanding General, Military District of Washington,
Room 1543, Building T-7, Gravelly Point, Va.

- 235-241 Technical Information Service, Oak Ridge, Tenn.
(Surplus)

ATOMIC ENERGY COMMISSION ACTIVITIES

- 242-244 U.S. Atomic Energy Commission, Classified Technical
Library, 1901 Constitution Ave., Washington 25, D.C.
ATTN: Mrs. J. M. O'Leary (For DMA)
245-246 Los Alamos Scientific Laboratory, Report Library, PO
Box 1663, Los Alamos, N. Mex. ATTN: Helen Redman
247-251 Sandia Corporation, Classified Document Division,
Sandia Base, Albuquerque, N. Mex. ATTN: Martin
Lucero
252-254 University of California Radiation Laboratory, PO Box
808, Livermore, Calif. ATTN: Margaret Edlund
255 Weapon Data Section, Technical Information Service,
Oak Ridge, Tenn.
256-300 Technical Information Service, Oak Ridge, Tenn.
(Surplus)

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